SIEMENS

ICs for Communications

1-Chip Car Radio

TUA 4306

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from July 22nd 1998

1 Features

1.1 AM/FM-Receiver

- High flexibility with an external preamplifier stage for AM and FM
- Strictly symmetrical RF parts
- Separate mixers for AM and FM mode
- Sym. or asym. mixer inputs
- Only one 2-pin-oscillator for the 1st LO; in AM mode the oscillator frequency is divided
- 1st LO with LC-tank circuit
- 1st LO at 100 MHz range
- 1st LO decoupled counter output
- 1st LO decoupled divided counter output
- Improved low phase noise
- FM/AM field strength output combined

1.2 FM-Mode

1.2.1 FM-Receiver

In this mode, the receiverpart is comprised of a mixer, an oscillator, a prestage control and an IF post amplification.

- Integrated AGC generation for PIN Diodes and MOSFETs
- High level mixer input
- High input/output 3rd order interceptpoint

1.2.2 FM-IF Demodulator

The FM-IF-demodulator has been developed especially for car radio applications.

- 7stage limiter amplifier
- Coincidence demodulator
- Field strength output (combined with AM)
- Fixed mute depth (with full muting typ 80dB)
- Multipath detector with analog output

1.3 Stereodecoder

This part provides the stereo decoder function and noise blanking for FM car radio applications.

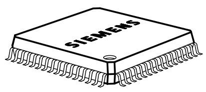
- Internal reference voltage source
- Adjustment free oscillator with ceramic resonator 456 kHz
- Pilot dependent mono/stereo switching with hysteresis
- Stereo indicator output
- Analog mono/stereo blend control (stereo noise control, SNC)
- Pilot canceller (19 kHz)
- Adjacent channel noise suppression (114 kHz)
- Mute facility
- Analog deemphasis control (high cut control, HCC)
- Interference noise detector with integrated high-pass filter (IF level signal or MPX input)
- MPX-input low-pass filter
- Noise blanking at MPX -demodulator outputs- L, R audio is common to AM Mode

1.4 AM Mode

In this mode, the IC is comprised of a mixer, an oscillator with a divider by 4, 6, 8 or 10, a prestage control, 2nd mixer to convert the 1st IF to the 2nd IF, 2nd local force oscillator (buffer for external source), automatic gain controlled amplifier and quasisynchronous demodulator.
The same oscillator is used in AM and FM mode.

- 2nd mixer with force input for mixing frequency
- Output for AM IF counter
- Wide range 2nd IF AGC amplifier
- Quasi synchronous demodulator for AM mode
- Fast AM search tuning stop feature
- HCC for AM

2 Pinning



MQFP64-1

Pin	Function	Pin	Function	Pin	Function
1	MP det in	23	IF amp bias	45	Deem L
2	MP det cap	24	IF amp in	46	AF out L
3	MP det out	25	+V rf	47	AF out R
4	AM seek m	26	GND rf	48	Vref H/S
5	AM IF count	27	SEL A	49	Contr. HCC
6	GND IF	28	SEL B	50	Contr. SNC
7	FM IF bias	29	1st mix out	51	Pil ind out
8	FM IF in	30	1st mix out	52	Pil det cap
9	AM IF bias	31	Pre cap AM	53	MPX in
10	AM IF in	32	Pre cap FM	54	Stereo PLL
11	AM IF bias	33	RF in FM	55	Stereo osc
12	2nd mix out	34	RF in FM	56	Iref stereo
13	2nd mix out	35	RF in AM	57	N det in
14	AM IF cap	36	RF in AM	58	MPX out
15	2nd LO	37	Vref RF	59	GND stereo
16	2nd mix in	38	1st LO	60	Mute FM
17	2nd mix in	39	1st LO	61	Dem FM
18	IF gain cap	40	Div count	62	Dem FM
19	IF amp out	41	Dir count	63	+Vif
20	V pre AM	42	Ng cap AM/FM	64	Fieldstr.
21	I pre FM	43	Nlev cap		
22	IF gain adj	44	Deem R		

3 Ordering Information

Type	Package	Ordering Code
TUA 4306	MQFP-64-1	Q67037-A1009

4. Circuit Description

General Description
The TUA 4306 is a one chip car radio system consisting of AM/FM receiver, AM-Up/Down conversion, AGC amplifier / demodulator, FM-IF limiter amplifier / demodulator and stereodecoder / noiseblanker.

4.1 AM/FM-Receiver

The AM/FM-receiver part includes a 2-pin varactor tuned oscillator. In the FM mode the direct oscillator frequency is fed into the double balanced FM mixer, in the AM mode the divided by 4, 6, 8 or 10 oscillator frequency is fed into the AM mixer.
The two separate symmetrical input stages of the IC, one optimized for FM-, the other for AM- mode allow symmetrical and unsymmetrical prestage configuration.
The AM and FM input frequencies are converted to a fix 1st IF in the 10.7 MHz range. The FM-IF is post amplified in a separate IF amplifier with DC adjustable gain, the AM-IF is fed directly to the 2nd mixer.
The TUA 4306 has been designed to work with a PLL in the 100MHz range in both modes or in the AM- mode with the divided frequency.
Depending on the input signal strength, the integrated AGC stage for prestage control drives PIN-Diodes as well as MOSFETs.

4.2 FM-MODE

FM-IF Demodulator
The FM-IF amplifier includes a 7 stage capacitive coupled limiter amplifier with coincidence demodulator and AF output. The AF output signal can be continuously attenuated to decrease the noise.
There is a field strength output (with min. 76 dB dynamic range, typ. ±1 dB nonlinearity and typ. ±3 dB temperature drift) and a fixed muting (with full muting typ 80 dB).
A multipath detector with analog output is available. Its input signal is fed from the high pass filter of the stereo-decoder/noiseblanker and a second 80 kHz 1-pole high pass filter.

4.3 Stereodecoder

Power supply, reference current:
A temperature-stable, low noise reference voltage generator is used for better ripple rejection and to generate a reference current. This current is used as a time base for the deemphasis, the gate time of the pulse former, and the pilot cancellation, avoiding temperature and tolerance effects .

MPX input, MPX filter:
A 4-pole low-pass filter determines the bandwidth of the MPX signal.

Voltage Controlled Oscillator, Phase Detector:
The 456 kHz oscillator and the frequency dividers are used as walsh function generators (suppression of 3rd order harmonics) for:
38 kHz for the stereo decoder
19 kHz inphase for phase detector and pilot cancellation
19 kHz quadrature for the phase detector.
The phase detector locks the on chip 19 kHz signal to the pilot tone in the MPX signal at 90 deg phase.

Pilot Detector, Pilot Indicator, Pilot Cancellation:
The voltage at the pilot detector output is proportional to the pilot tone input level. If that level is high enough, the pilot indicator output is activated and the pilot cancellation turned on: a 19 kHz signal proportional to the voltage at the pilot detector output is added to the MPX signal with inverse polarity, cancelling the 19 kHz pilot tone.

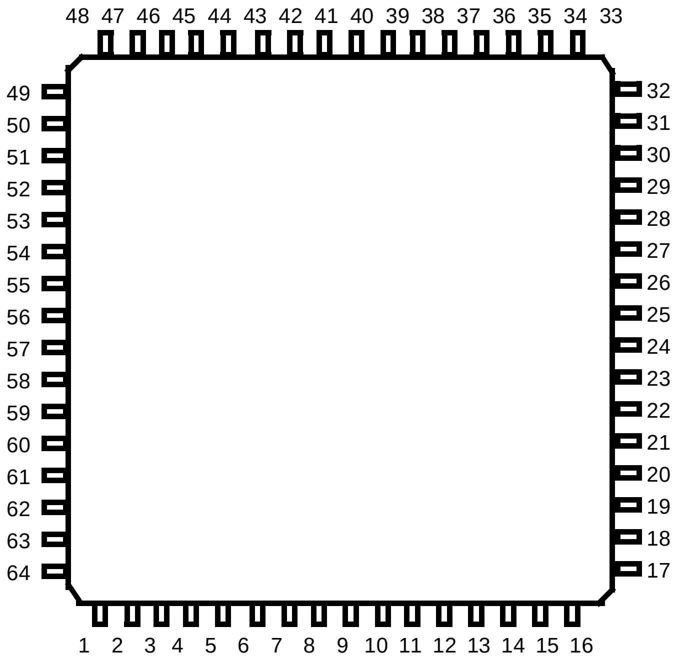
Interference Detector , Noise Detector, Pulse Former:
The signal from the interference input (MPX or field strength signal) passes a 4-pole high-pass filter to the noise blanking circuitry. The average noise level is stored in an external capacitor. The interference detector compares the actual noise level with that stored on the capacitor and triggers the pulse former if there is a sig-

nificant difference. The pulse former generates a gate pulse for the HCC block. During that pulse time the outputs of the deemphasis circuit are switched to hold mode.

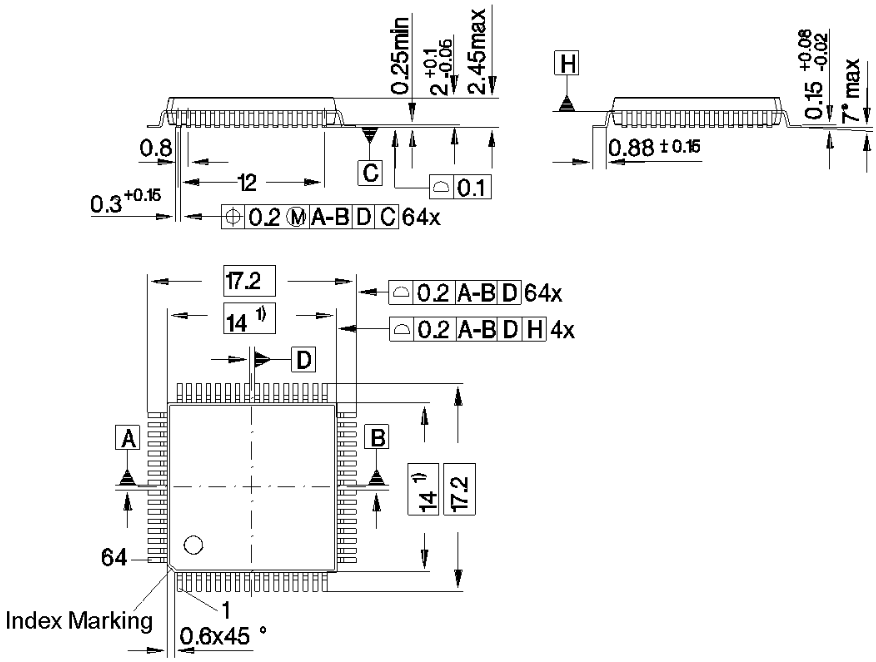
4.4 AM - MODE

In the AM mode the 1st IF is converted by the 2nd mixer into the 2nd IF in the 450 kHz range. Therefore a 2nd LO force input is part of the IC. The 2nd IF signal passes an automatic gain controlled IF amplifier and is then demodulated to the AF in a quasisynchronous demodulator. Switching to seek mode, the AGC time constant is reduced by a factor of 5, the AM IF counter output is switched on and the AF is muted. The AGC voltage is used as AM field strength and is fed to the combined field strength output.

5 Pin Configuration



P-MQFP 64-1



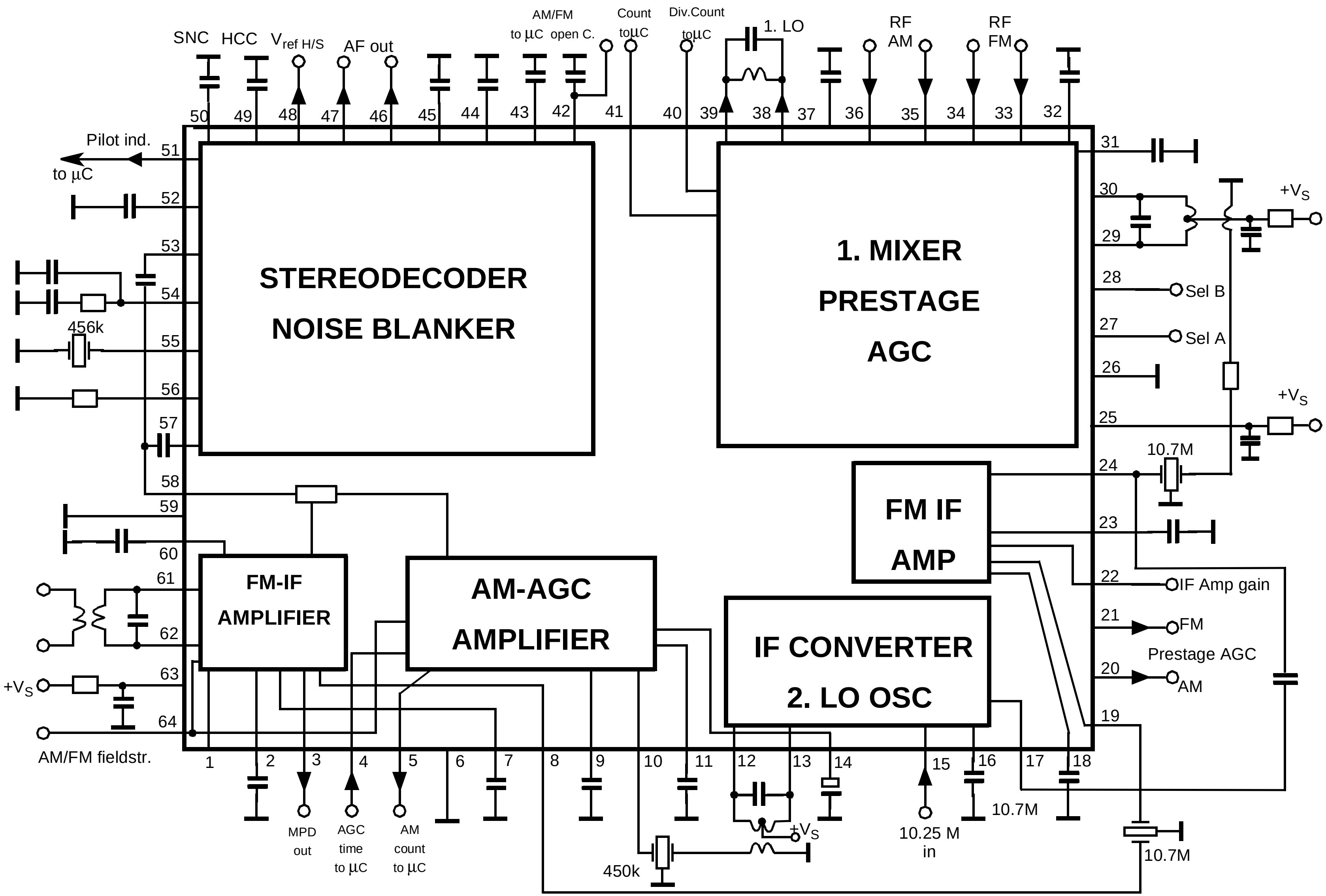
Does not include plastic or metal protrusion of 0.25 max. per side

6 Pin Description

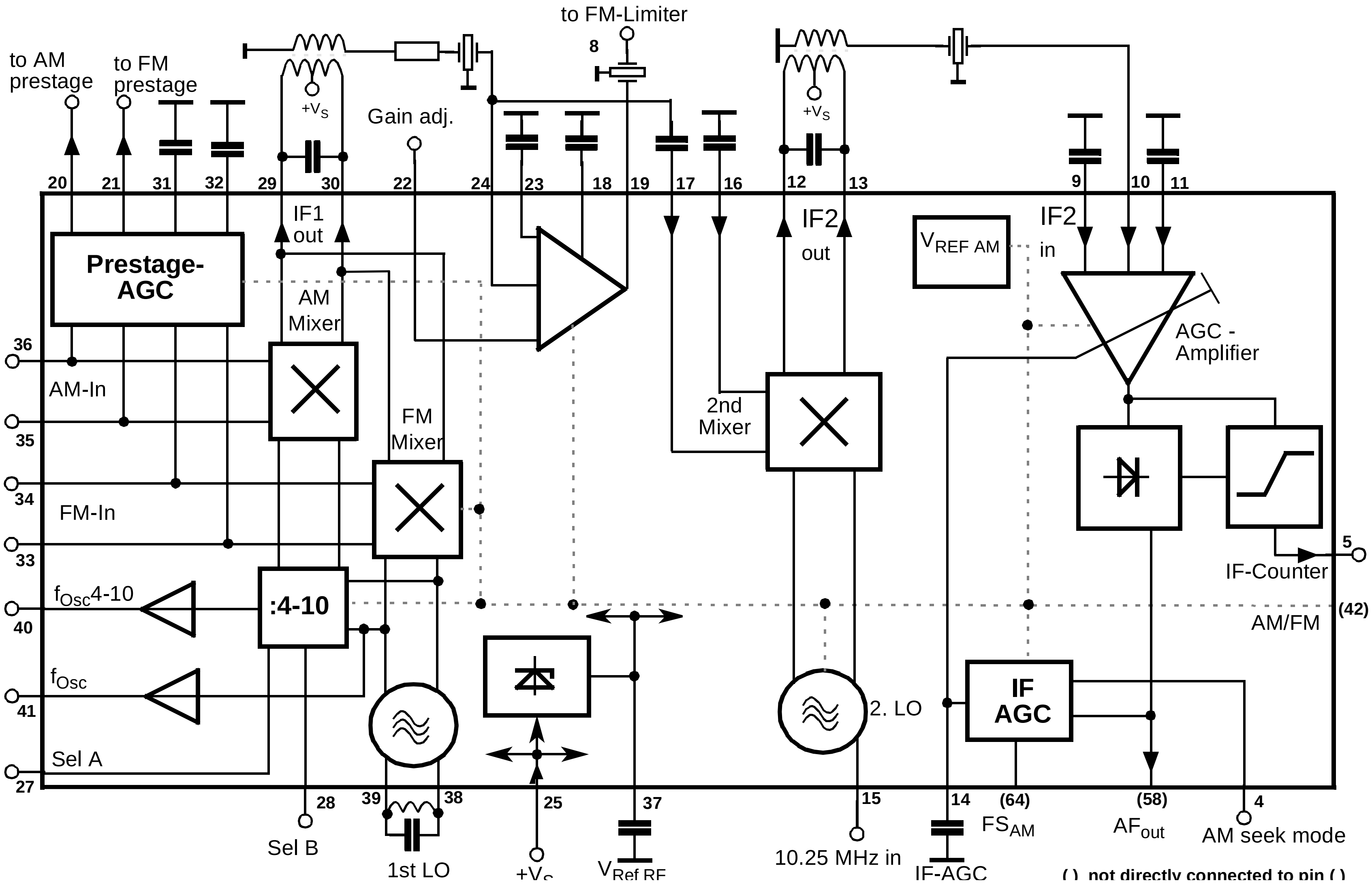
Pin No.	Symbol	Function
1	MP det in	Auxiliary multipath detector input (in parallel to internal connection)
2	MP det cap	Multipath detector rectifier capacitor
3	MP det out	Analog multipath detector output
4	AM seek m	AM seek mode switch; AM IF counter on, AM-AGC fast and AF-mute
5	AM IF count	AM-IF counter output for search tuning
6	GND IF	Ground IF
7	FM IF bias	FM limiter input bias decoupling capacitor
8	FM IF in	FM limiter input
9	AM IF bias	AM AGC amplifier bias decoupling capacitor
10	AM IF in	AM AGC amplifier input
11	AM IF bias	AM AGC amplifier bias decoupling capacitor
12	2nd mix out	2nd AM mixer output (open collector)
13	2nd mix out	2nd AM mixer output (open collector)
14	AM IF cap	AM AGC amplifier time constant capacitor
15	2nd LO	Frequency force input for 2nd mixer
16	2nd mix in	2nd AM mixer bias decoupling capacitor
17	2nd mix in	2nd AM mixer input
18	IF gain cap	10.7 MHz FM IF amplifier gain adjust blocking capacitor
19	IF amp out	10.7 MHz FM IFamplifier output
20	V pre AM	AM prestage AGC buffered voltage output
21	I pre FM	FM prestage AGC current output for PIN diode
22	IF gain adj	10.7 MHz FM IF amplifier DC controlled gain adjust
23	IF amp bias	10.7 MHz FM IF amplifier operation point
24	IF amp in	10.7 MHz FM IF amplifier input
25	+V rf	Supply voltage RF section
26	GND rf	Ground RF section
27	SEL A	AM divided counter ratio select A
28	SEL B	AM divided counter ratio select B
29	1st mix out	1st mixer output (open collector)
30	1st mix out	1st mixer output (open collector
31	Pre cap AM	AM prestage AGC time constant capacitor
32	Pre cap FM	FM prestage AGC time constant capacitor; output for MOS FET Gate 2
33	RF in FM	FM 1st mixer symmetrical inputs

Pin No.	Symbol	Function
34	RF in FM	FM 1st mixer symmetrical inputs
35	RF in AM	AM 1st mixer symmetrical inputs
36	RF in AM	AM 1st mixer symmetrical inputs
37	Vref RF	Reference voltage RF section (4.8 V)
38	1st LO	1st local AM/FM oscillator circuit
39	1st LO	1st local AM/FM oscillator circuit
40	Div count	1st local oscillator divided by 4, 6, 8 or 10 counter output (disabled in FM mode)
41	Dir count	1st local oscillator counter output
42	Ng cap AM/FM	Timing capacitor for Noisedetector monoflop (gate time) AM/FM mode control; low voltage activates AM section and disables stereodecoder VCO, Phase detector, Pilot detector, SNC and FM section
43	Nlev cap	Hold capacitor for Noise detector average level low voltage applied mutes the stereo decoder outputs
44	Deem R	HCC timing / hold capacitor, deemphasis right
45	Deem L	HCC timing / hold capacitor, deemphasis left
46	AF out L	AF output left
47	AF out R	AF output right
48	Vref H/S	Reference voltage SNC / HCC
49	Contr. HCC	Control voltage HCC (high cut control)
50	Contr. SNC	Control voltage SNC (stereo noise control), external decreasing of stereo separation possible
51	Pil ind out	Pilot indicator output, active high (open collector)
52	Pil det cap	Pilot detector capacitor, low voltage activates mono state
53	MPX in	Stereo decoder MPX signal input
54	Stereo PLL	Stereo decoder PLL phasedetector, loop filter
55	Stereo osc	VCO pin for ceramic resonator
56	Iref stereo	Reference current pin, external reference resistor
57	N det in	Noise detector input
58	MPX out	FM MPX signal and AM demodulator signal output
59	GND stereo	Ground stereodecoder
60	Mute FM	Dynamic FM mute control blocking capacitor
61	Dem FM	Demodulator circuit FM
62	Dem FM	Demodulator circuit FM
63	+Vif	Supply voltage IF and stereodecoder section
64	Fieldstr.	AM/FM fieldstrength combined output

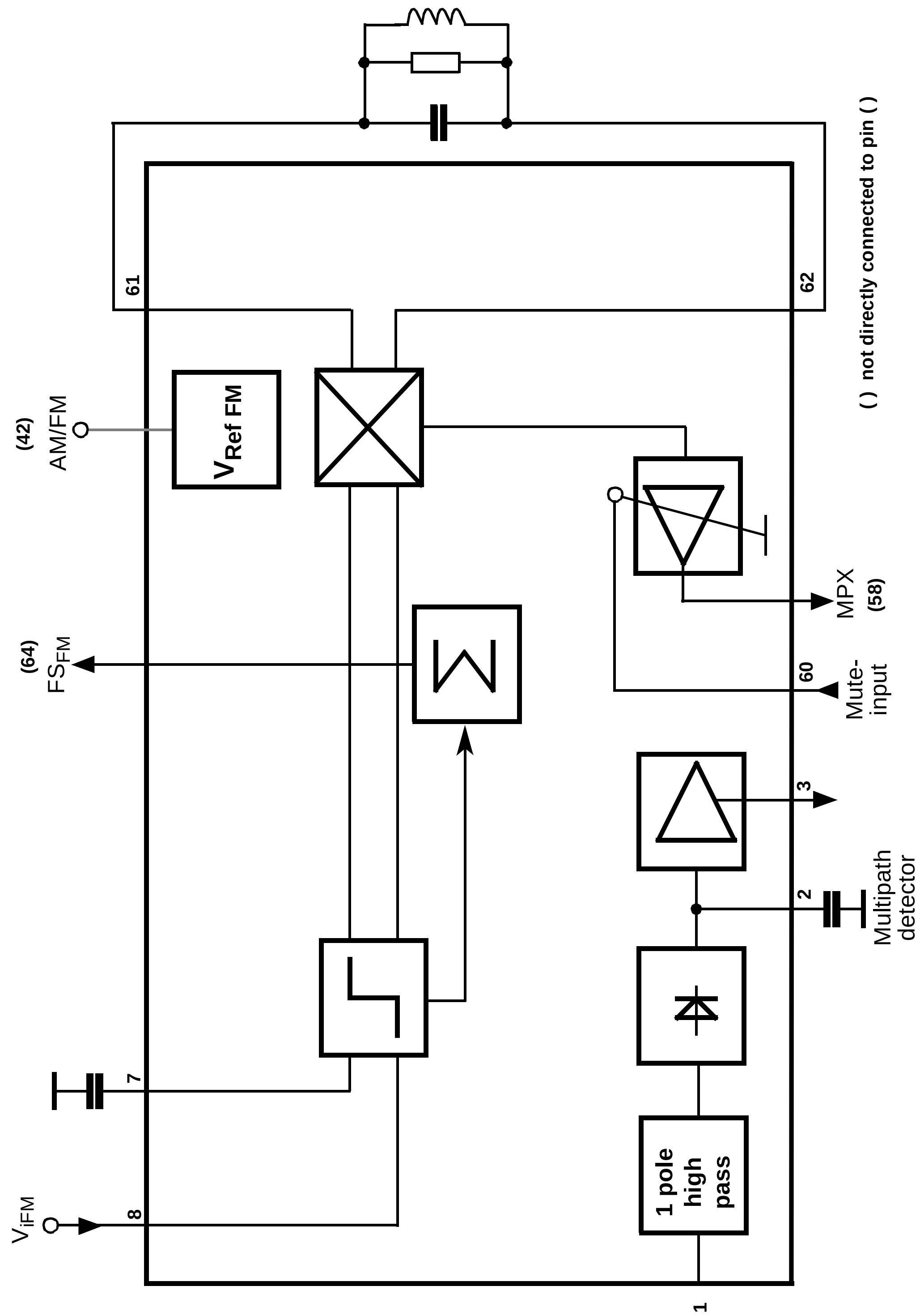
7 Blockdiagram 1



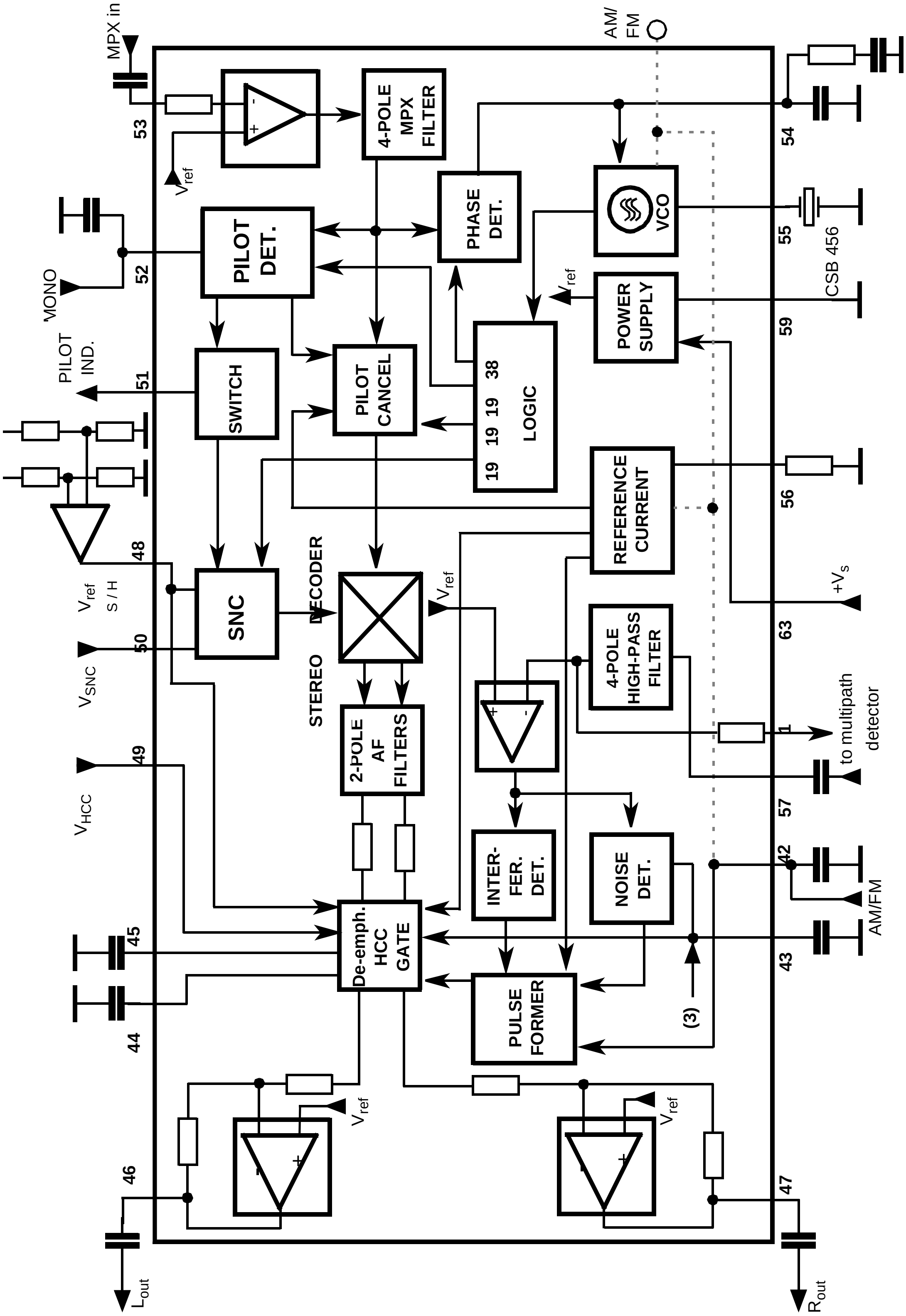
8 Blockdiagram 2



9 Blockdiagram 3



10 Blockdiagram 4



11 Absolute Maximum Ratings

The AC / DCcharacteristic limits are not guaranteedhe maximal ratings may not be exceeded under any circumstances, not even momentary and individual, as permanent damage to the IC will result.

Parameter	Symbol	Limit Values		Unit	Test Conditions
		min	max		
Junction temperature	T_J	-40	150	°C	
Storage temperature	T_S	-40	125	°C	
Thermal resistance	R_{thSA}		54	K/W	
ESD-voltage, HBM	V_{ESD}	-4	+4	kV	100pF, 1500 Ω

Ambient Temperature under bias: T_A=-40 to +85°C

12 Operational Range

Within the operational range the IC operates as described in the circuit description. The AC / DC characteristic limits are not guaranteed
.

Parameter	Symbol	Limit Values		Unit	Test Conditions
		min	max		
Supply voltage	V_S	8	9	V	
Ambient temperature	T_A	-40	85	°C	

13 AC / DC Characteristics

AC / DC characteristics involve the spread of values guaranteed within the specified supply voltage and ambient temperature range. Typical characteristics are the median of the production.

Supply Voltage **V_S = 8.5 V**
Ambient temperature **T_{amb} = 25 °C**

Parameter	Test Circuit	Symbol	Limit Values min	typ	max	Unit	Test conditions
1.Current consumption	1	I_{SFM}	**80**	100	**120**	mA	**FM** mode
	1	I_{SAM}	**65**	80	**105**	mA	**AM** mode
1.AM/FM-Receiver **1st LO**							
1. Frequency range	1	$f_{1st\ LO}$	80		140	MHz	
2. Frequency range	Lab	$f_{1st\ LO}$	50		150	MHz	$Q_{factor\ of\ coil}$ >90
3. Counter output	1	V_{41}	**70**	**100**		mV_{rms}	R_{L41}=330Ω; Ref. Appl.board
4. Divided counter output	1	V_{40}	**28**	**40**		mV_{rms}	R_{L40}=330Ω; Ref. Appl. board
4a. Divided counter output	**Lab**	V_{40}		**150**		mV_{rms}	R_{L40}=10kΩ; Ref. Appl. board
5. Output impedance	Lab	R_{40}	0.8	1	1.2	kΩ	
6. Output impedance	Lab	R_{41}	240	300	360	Ω	
7. Frequency	1	$f_{1st\ LO}$	10			MHz	V_{tuning}=0V
10.7 MHz IF amplifier f_{IF1}= 10.7 MHz							
8. DC input voltage	1	V_{24}	**3.5**	**3.9**	**4.3**	V	
9. Input resistance	1	R_{24}	270	330	390	Ω	AM
10. Output resistance	1	R_{19}	270	330	390	Ω	
11. Max. voltage gain	1	A_{24-19}	**23**	26	**29**	dB	V_{22}=1.5V
12. Min. voltage gain	1	A_{24-19}	**13**	16	**19**	dB	V_{22}=3.5V
13. Noise figure	Lab	F_{FM}		7		dB	RG=330Ω
14. Reference voltage	1	V_{37}	4.5	4.8	5.1	V	
15. Output Current	1	I_{37}			1	mA	

Parameter	Test Circuit	Symbol	Limit Values			Unit	Test conditions
			min	typ	max		
AM mode f_{IF1}= 10.7 MHz f_{IF2}= 450 kHz $f_{35\text{-}36}$= 1 MHz V_{42}=1V							
Mixer 1							
1. Interceptpoint 3rd order	Lab	I_{P3}		134		dBµV	Special testcircuit necessary
2. Mixer gain	1	A_{M1}	**2**	6	**10**	dB	$V_{35,36}$=80mV_{rms} (R_L=330Ω)
3. Max. input voltage	1	$V_{35\text{-}36}$	1100	1400		mV_{pp}	SINAD> 34dB;m=80%
4. Noise figure (10 MHz)	Lab	F		7		dB	$R_{g\ opt}$=700Ω
5. Input impedance	Lab	$R_{35\text{-}36}$	3.2	4	4.8	kΩ	sym.
6. Input impedance	Lab	$C_{35\text{-}36}$	1.6	2	2.4	pF	sym.
7. Input impedance	Lab	$R_{35\text{-}36}$	1.6	2	2.4	kΩ	asym.
8. Input impedance	Lab	$C_{35\text{-}36}$	3.2	4	4.8	pF	asym.
9. Divider select low	1	$V_{27,28L}$	0		**1.3**	V	
10. Divider select high	1	$V_{27,28H}$	3.0		V_s	V	
Prestage AGC output							
11. AGC-voltage AM	1	V_{20}	6.5	7.5		V	$V_{35,36}$ =50mV_{rms}
12. AGC-voltage AM	1	V_{20}	0		0.5	V	$V_{35,36}$ =200mV_{rms}
13. AGC-voltage FM	1	V_{32}	0		0.15	V	$V_{35,36}$=50mV_{rms}
14. AGC-current FM	1	I_{21}	0		0.1	mA	$V_{35,36}$=50mV_{rms}
15. Integrator Current	1	I_{31}*	-12	-25	-45	µA	$V_{35,36}$=50mV_{rms} V_m=3V
16. Integrator Current	1	I_{31}*	+10	**+25**	+40	µA	$V_{35,36}$=150mV_{rms} V_m=3V
17. Integrator Current	1	I_{31}*	-17	-35	-55	µA	$V_{35,36}$=0mV_{rms} V_m=3V
18. Integrator Current	1	I_{31}*	+50	+70	+90	µA	$V_{35,36}$=400mV_{rms} V_m=3V

Parameter	Test Circuit	Symbol	Limit Values			Unit	Test conditions
			min	typ	max		
2 nd AM IF section Mixer 2							
1. Mixer gain	1	A_{M2}	**7**	**10**	**13**	dB	V_{17} =1mV; V_{out}=V_{IF450} f_{17}=10.7 MHz; f_{15}=10.25 MHz
2. Noise figure	Lab	F		10		dB	
3. Max Input Voltage	1	V_{16-17}		1400		mV_{pp}	SINAD> 34dB;m=80%
4. Input impedance	Lab	R_{16-17}		1.8	-	kΩ	
Frequency force input							
5. Operational frequency	Lab	f_{15}	10	10.25	25	MHz	
6. External force voltage	1	V_{15}	**60**			mV_{rms}	Rg=600Ω; Ck= 100pF

Parameter	Test Circuit	Symbol	Limit Values			Unit	Test conditions
			min	typ	max		
FM mode f_{IF}=10.7 MHz $f_{33\text{-}34}$=100 MHz V_{42}=open							
Mixer 1							
1.Interceptpoint 3rd order	Lab	I_{P3}		125		dB µV	special testcircuit necessary
2.Noise figure (10 MHz)	Lab	F		6		dB	$R_{g\ opt}$=500Ω
3. Mixer gain	1	A_{M1}	**5**	9	**13**	dB	$V_{33\text{-}34}$=10mV_{rms}; R_L=330Ω
4.Input impedance	Lab	$R_{33\text{-}34}$	3.2	4	4.8	kΩ	sym.
5.Input impedance	Lab	$C_{33\text{-}34}$	1.6	2	2.4	pF	sym.
6.Input impedance	Lab	$R_{33\text{-}34}$	1.6	2	2.4	kΩ	asym.
7.Input impedance	Lab	$C_{33\text{-}34}$	3.2	4	4.8	pF	asym.
Prestage AGC output							
8. AGC voltage FM	1	V_{32}	5.6	6.4	**7.2**	V	$V_{33,34}$=0mV_{rms}
9.AGC voltage FM	1	V_{32}	0		**0.1**	V	$V_{33,34}$=50mV_{rms}
10.AGC current FM	1	I_{21}	9.5	12	14.5	mA	$V_{33,34}$=0mV_{rms} V_m=0.7V
11.AGC current FM	1	I_{21}	0		0.1	mA	$V_{33,34}$=50mV_{rms} V_m=0.7V
12.AGC voltage AM	1	V_{20}	0		0.5	V	$V_{33,34}$=0
13.AGC sink current AM	1	I_{20}	3			mA	$V_{33,34}$=0
14.AGC voltage AM integrator	1	V_{31}		6	7.5	V	$V_{33,34}$=0
15.Integrator Current	1	I_{32}*	- 12	**-** 25	- 46	µA	$V_{33,34}$=0 V_m=4.8V
16.Integrator Current	1	I_{32}*	+15	+30	+50	µA	$V_{33,34}$=60mV_{rms} V_m=4.8V
17.Integrator Current	1	I_{32}*	+50	**+70**	+90	µA	$V_{33,34}$=150mV_{rms} V_m=4.8V

*) Integrator currents are measured between the output pin (- Pole of the measurement equipment) and a voltage source V_m (+ Pole)

2.FM Demodulator
Measuring condition:
f_{iIF}=10.7 MHz; Δf= ±75 kHz; f_{mod}= 1 kHz;V_8 =10 mV_{rms}
V_{42}=open; Deemphasis= 100 µs

Fieldstrength dynamic range	1	V_{64}	66	72		dB	see Diagram D1
Fieldstrength nonlinearity	1	V_{64}		±1		dB	see Diagram D2
Fieldstrength temperature drift	1	V_{64}			±3	dB	see Diagram D3

Parameter	Test Circuit	Symbol	Limit Values min	typ	max	Unit	Test conditions
Fieldstrength load capacitance	Lab				50	pF	
Fieldstrength load resistance	Lab		1			kΩ	
Fieldstrength voltage	1	V_{64}	4	4.6	5.2	V	V_8=200mV_{rms}
Fieldstrength voltage	1	V_{64}	1.5	1.9	2.3	V	V_8=1mV_{rms}
Fieldstrength voltage	1	V_{64}	0		1	V	V_8=0mV_{rms}
2. AF-output voltage	1	V_{58}	400	500	600	mV_{rms}	R_L>10kΩ; Deemph.=100 µs
3. AF-output voltage	Lab	V_{58}		600		mV_{rms}	R_L>10kΩ; no Deemph.
4. Input voltage for limiter threshold	1	V_8		33	45	µV_{rms}	V_{58}=V_{58} - 3dB
5. Total harmonic distortion	1	THD_{58}		**0.9**	1.2	%	
6. AM-suppression	1	a_{AM}	70	80		dB	m=30 %
7. Signal-to-noise ratio	1	$a_{S/N}$	72	80		dB	
8. AF mute	1	a_{AF}	**12**	14	**16**	dB	V_{60}=0
Multipath detector f_{57}=200 kHz							
10. Attack current	1	I_2 *)	600	800	1070	µA	V_{57AC}=1V_{pp} , V_m=5.0 V
11. Recovery current	1	I_2 *)	- 6	- 9	-12	µA	V_{57AC}=0; V_m=3.6V
12. Start voltage	1	V_{3Def}	4.4	4.7		V	V_{57AC}=0V
13.Detector characteristic	1	V_3	$V_{3Def0.14V}$	$V_{3Def-0.1V}$	V_{3Def}	V	f_{57}=25kHz; V_{57}=160mV_{pp}
14. Detector characteristic	1	V_3	$V_{3Def-3.3V}$	$V_{3Def-2.8V}$	$V_{3Def-2.3V}$	V	f_{57}=200kHz; V_{57}=160mV_{pp}

*) Integrator currents are measured between the output pin (- Pole of the measurement equipment) and a voltage source V_m (+ Pole

Parameter	Test Circuit	Symbol	Limit Values			Unit	Test conditions
			min	typ	max		

3.Stereodecoder
Measuring condition:
V_{53}=600mV_{rms}; f=1 kHz; 15kHz LP with 19kHz Notch; see appendix

1.Total harmonic distortion	1	$THD_{46,47}$		0.1	0.3	%	f= 1 kHz
2. Signal to noise ratio	1	$S/N_{46,47}$	65	75		dB	Stereo
3. Channel separation	1	a_{Sep}	28	40		dB	
4. AF output voltage	1	$V_{46,47}$	**650**	780	**900**	mV_{rms}	Stereo/Mono
5. Overdrive margin	1	$V_{46,47\ max}$		2		dB	THD= 1%
6. AF output DC voltage	1	$V_{DC\ 46,47}$	2.5	3	3.5	V	
7. Difference of output voltage levels	1	$\Delta V_{46,47}$			2	dB	
8. Muting depth	1	$A_{46,47}$	70	75		dB	V_{43}=0
9. Muting depth	1	$A_{46,47}$	70	75		dB	V_4=0.7V
10. DC-offset at mute	1	$\Delta_{DC\ 46,47}$	-100	0	100	mV	
11. DC-offset stereo on/off	1	$\Delta_{DC\ 46,47}$	-100	0	100	mV	
Carrier and harmonic suppression (referenced to $V_{46,47}$=780 mV_{rms})							
1. Pilotsignal (f=19kHz) subcarrier	1	α_{19}	40	45		dB	
2. (f=38kHz)	1	α_{38}	40	50		dB	
3. (f=57kHz)	1	α_{57}	40	50		dB	
Mono/Stereo control Pilot threshold voltage:							
1. For stereo"on"	1	V_{PILon}		20	30	mV_{rms}	
2. For stereo"off"	1	V_{PILoff}	5	14		mV_{rms}	
3. Hysteresis	Lab			3		dB	V_{PILon} / V_{PILoff}
Stereo-indicator output							
4. Pilot off		V_{51off}			0.5	V	I_{51}=1mA
5. Pilot on					10	µA	
external control voltages (active low)							
6. Operational voltage for external mono control (pin 52)	1	$V_{52\ thr}$			1	V	
7. Operational voltage for AM/FM (pin 42)	1	V_{42thr}			1	V	AM on

Deemphasis Reference frequency = 400Hz C_{deemph}=10nF; τ_{nom}=75 µs							
8. Minimum FM attenuation	1	$A_{min\ FM}$	5	**7**	9	dB	V_{49}≥3.8V; f_m=5kHz
9. Maximum FM attenuation	1	$A_{max\ FM}$	**12**	**15**	**18**	dB	V_{49}=1.5 V V; f_m=5kHz
10. Minimum AM attenuation	1	$A_{min\ AM}$	5	**7**	9	dB	V_{49}≥3.4V; f_m=5kHz
11. Maximum AM attenuation	1	$A_{max\ AM}$	**12**	**15**	**18**	dB	V_{49}=1.5V; f_m=5kHz
Stereo/Mono blend control :							
1. Channel separation	1	a_{Sep}	28			dB	V_{50}=3.8V
2. Channel separation	1	a_{Sep}			3	dB	V_{50}=3.3V
Oscillator							
3. Max. Osc. frequency	1	f_{oscmax}	0.7	1.0	2.0	%	100 % x (f_{max} / 456kHz-1)
4. Min. Osc. frequency	1	f_{oscmin}	-2.0	-1.0	-0.7	%	100 % x (f_{max} / 456kHz-1)
5. VCO-gain	1		-12	-8	-4	kHz/V	$\Delta f/\Delta V_{54}$
6. Oscillator voltage	1		2.5	4	5.5	V	$V_{55\ DC}$
7.Oscillator swing	1		260	370	470	mV_{rms}	$V_{55\ AC}$
PLL							
8. PD-gain	note 1	$\Delta i/\Delta\phi$	6.0	8.2	10.2	µA/rad	V_{pilot} = 54 mV_{rms}
Noise detector							
9. Input resistance	Lab	R_{57}	80	99	120	kΩ	
10. Input high-pass filter	Lab	f_{in57}	80	100	120	kHz	-3dB
11.Trigger threshold	1	$V_{57\ min}$		30	50	mV_{rms}	V_{43} = V_{43} ($V_{57\ mean}$=0), f_{57}=200 kHz
12.Trigger threshold	1	$V_{57\ dyn}$	130	170	210	mV_{rms}	V_{43} =V_{43} ($V_{57\ mean}$=50mV_{rms}), f_{57}=200 kHz
13. Maximum noise mean value *	1	$V_{57maxmean}$	65	80	115	mV_{rms}	f_{57}=200 kHz
14. Suppression pulse duration	1		34	40	46	µs	
15. Input offset current	Lab	$I_{44,45}$	-50	0	50	nA	
16. Attack current	Lab	I_{43att}		**880**		µA	V_{43}=5.5V
17. Recovery current	Lab	I_{43rec}		20		µA	V_{43}=4V

***)** The trigger threshold is adapted to the input noise. IF max. noise mean value is exceeded, threshold is too high for any trigger of the noise blanker

4.AM Mode

AGC-Amplifier
Measuring condition:
f_{iF}= 450 kHz; f_{mod} = 1 kHz; V_{10} = 10mV_{rms} , Deemphasis=100 µs

1. AGC-range	1	ΔA	60	66		dB	V_{58}=V_{58AM} ±3dB
2. Input sensitivity	1	V_{10}		100		µV_{rms}	V_{58}=V_{58AM} -3dB
3. AGC time seek mode on	1	$V_{4\ L}$	0		0.7	V	
4. AGC time seek mode off	1	$V_{4\ H}$	2.4		5	V	
5. Integrator Current	1	I_{14}*	15	25	35	µA	V_{10}=0; V_m=3V
6. Integrator Current	1	I_{14}*	- 13	- 25	-33	µA	V_{10}=100mV_{rms} ; V_m=3V
7. Integrator Current	1	I_{14}*	400	+500	650	µA	V_{10}=0 V_m=3V; V_4=0.7 V
8. Integrator Current	1	I_{14}*	-400	- 500	-650	µA	V_{10}=100mV_{rms} ; V_m=3V; V_4=0,7 V
9. Field strength output	1	V_{64}	0	**0.3**	**0.8**	V	V_{10}=0 mV; seek mode off
10. Field strength output	1	V_{64}	**1.4**	1.75	**2.1**	V	V_{10}=500 µV; seek mode off
11. Field strength output	1	V_{64}	**3**	3.4	**4**	V	V_{10}=5 mV; seek mode off
12. Field strength output	1	V_{64}	**4**	4.4	**5.1**	V	V_{10}=30 mV; seek mode off

***)** Integrator currents are measured between the output pin (- Pole of the measurement equipment) and a voltage source V_m (+ Pole

Demodulator

13. AF output voltage	1	V_{58AM}	360	480	600	mV_{rms}	m=0.8
14. AF output voltage	Lab	V_{58AM}	283	406	550	mV_{rms}	m=0.8; Deemph=100 µs
15. Total harm. distortion	1	THD_{58}		0.7	2.5	%	
16. (S+N)/N	1		**40**	**50**		dB	m=0.8; V_{10}=200µV
17. (S+N)/N	1		**60**	**70**		dB	m= 0.8; V_{10}=100mV_{rms}
18. AF-linearity	1	Δ_{V58}			3	dB	

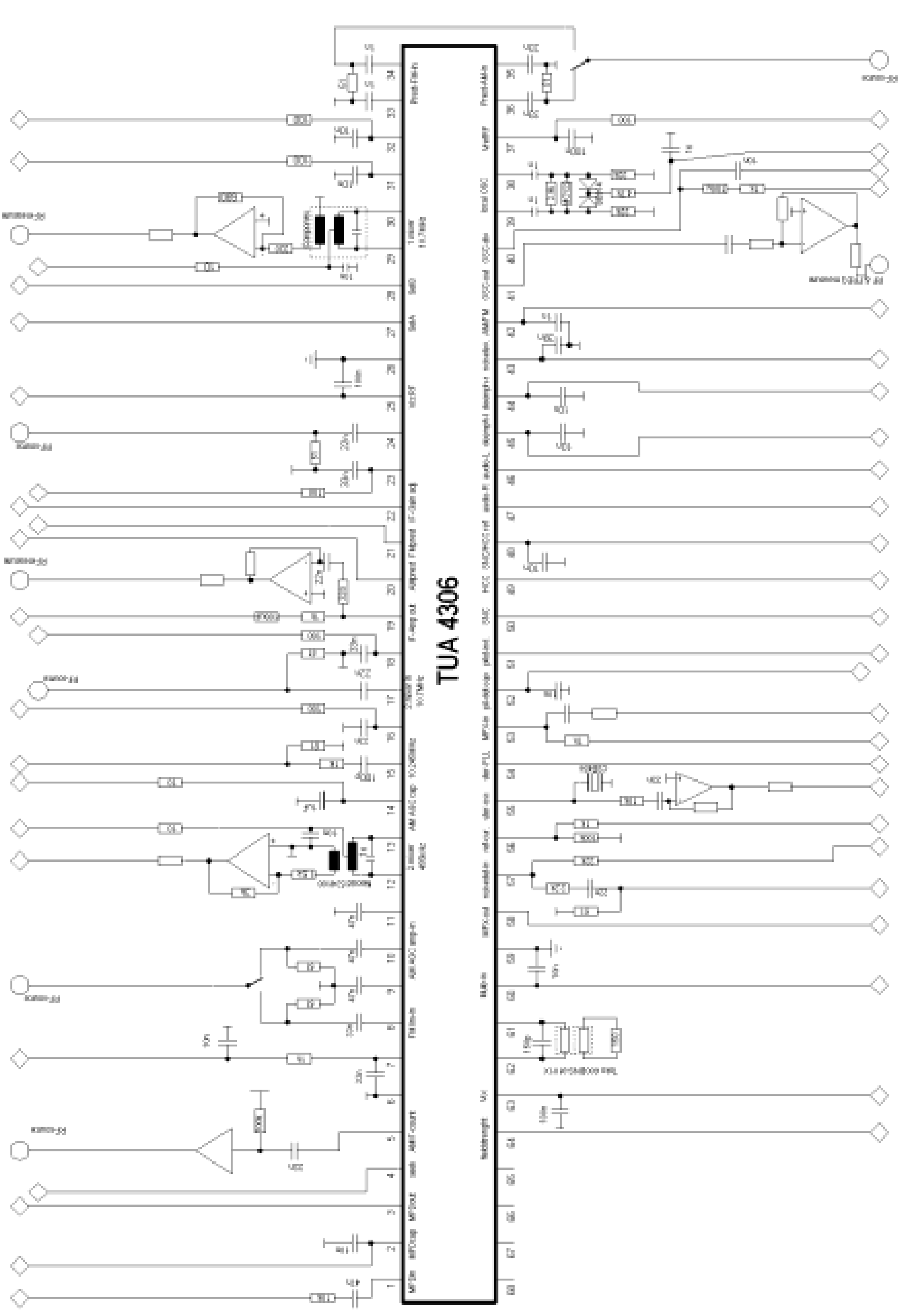
IF - Counter

19. IF - counter Output voltage	1	V_5	**220**	**270**		mV_{rms}	R_L=100kΩ V_4=0.7 V; Ref. Appl. Board
20. IF-counter output voltage	1	V_5			**0.5**	V_{DC}	V_4=2.4V
21. IF-counter Output voltage	1	V_{5AC}			2	mV_{rms}	V_4=2.4V

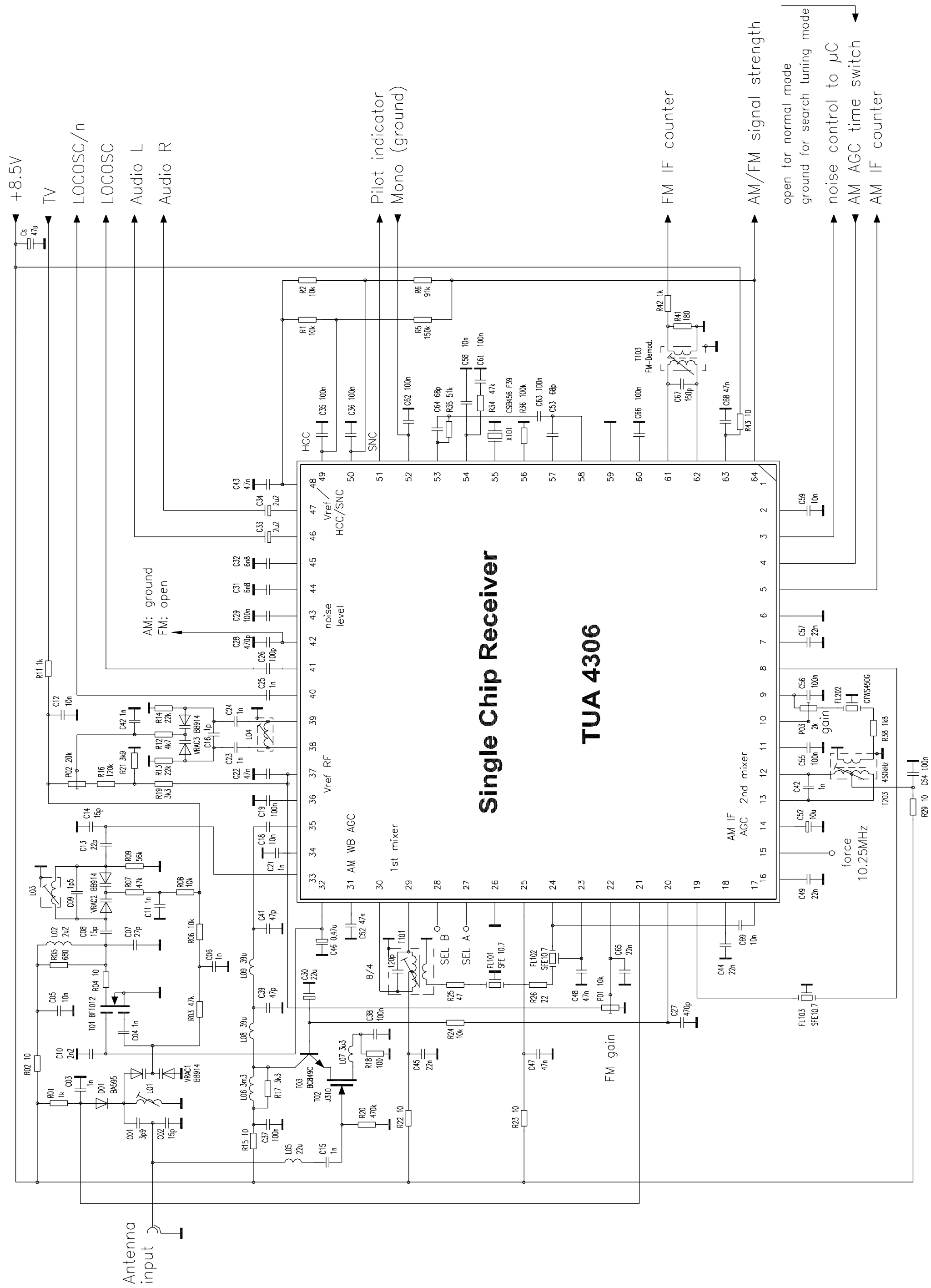
14 Truthtables

AM 1st LO ECL divider truthtable							
	Sel A	**Sel B**					
divide by 4	0	0					
divide by 6	0	1					
divide by 8	1	0					
divide by 10	1	1					

15 Test Circuit

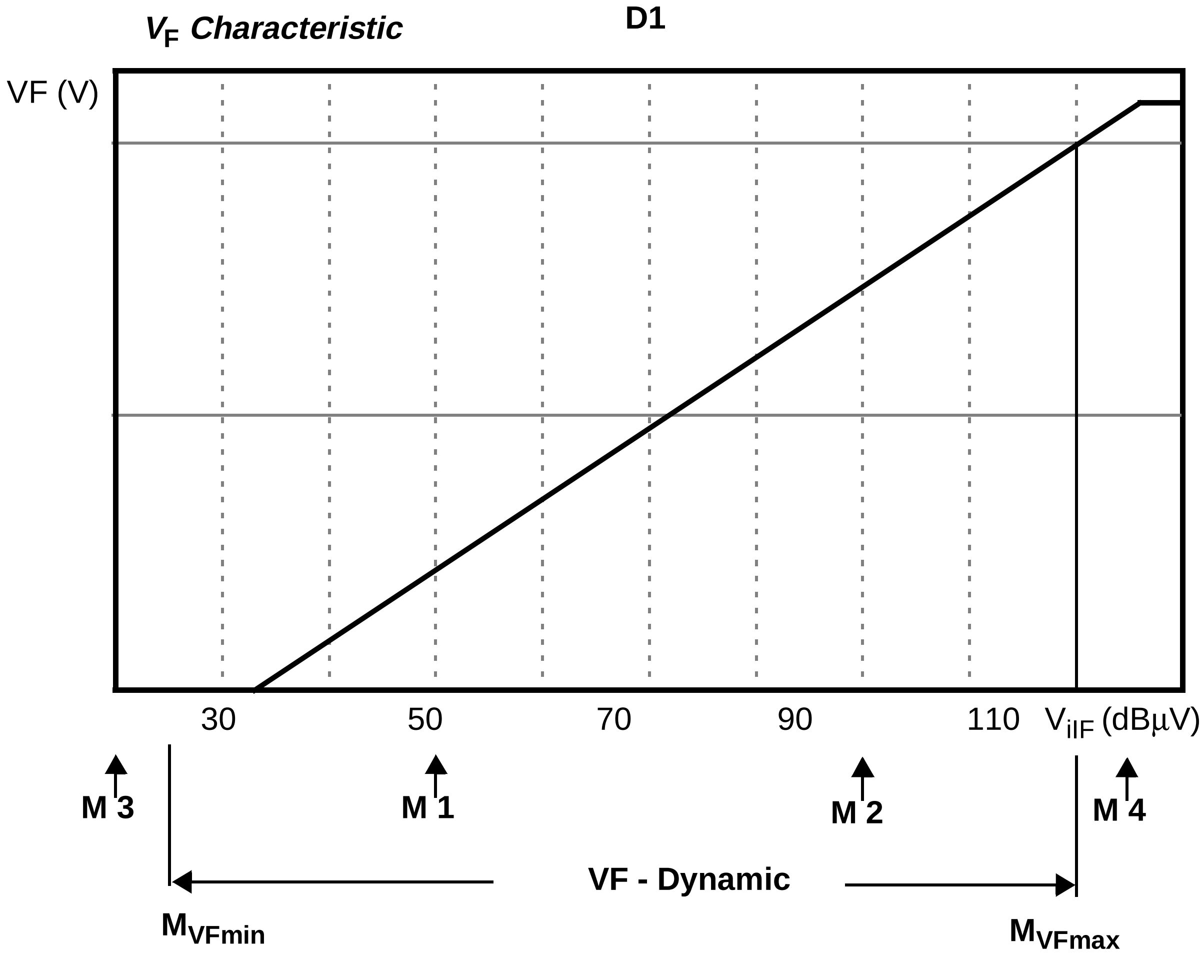


16 Application Circuit



Application Circuit

17 Diagram 1



V_F - Dynamic :The dynamic range of VF voltage is determined by the test points M1 through M4 as follows:

M1: test point (at V_{iIF}= 50 dBµV) supplies V_F (M1)
M2: test point (at V_{iIF}= 90 dBµV) supplies V_F (M2)
M3: test point (at V_{iIF}= 20 dBµV) supplies V_F (M3)
M4: test point (at V_{iIF}=120 dBµV) supplies V_F (M4)

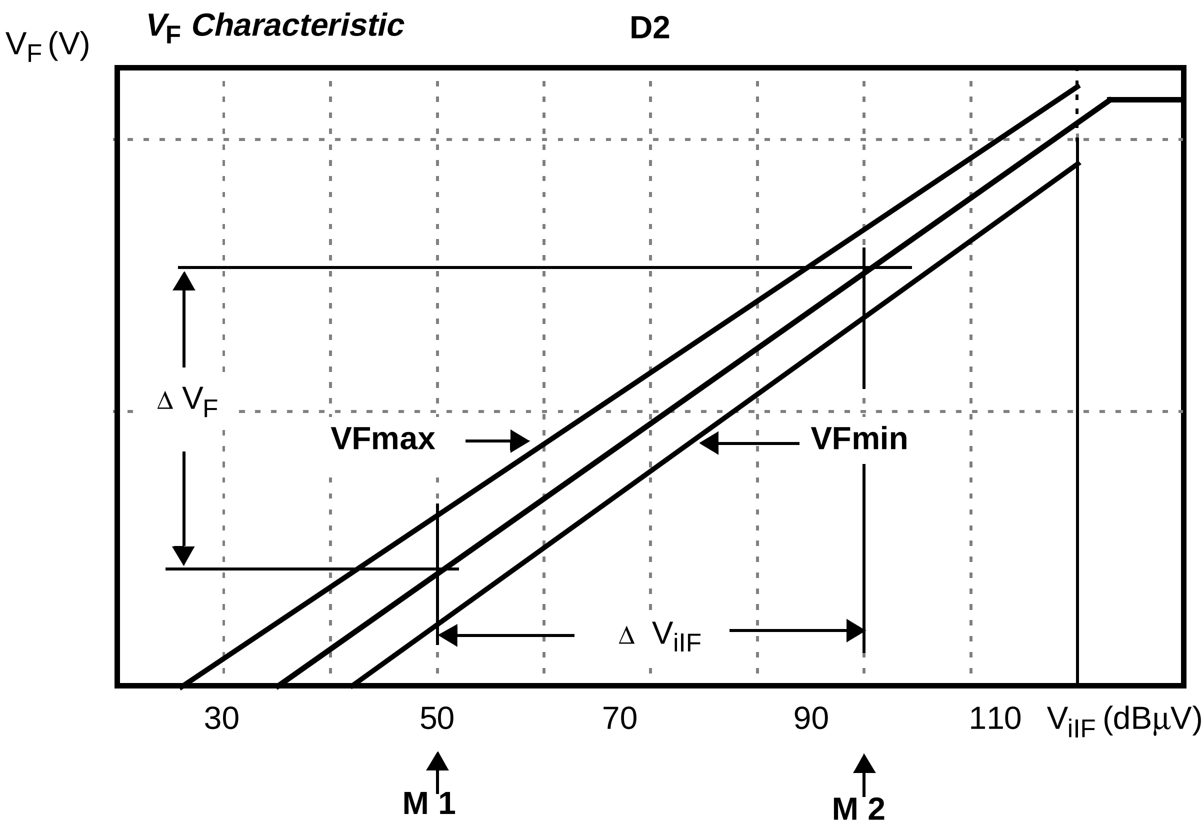
Hence follows :

$$M_{VFmax} := 90\ \mathrm{dB\mu V} + \frac{V_F(M4) - V_F(M2)}{V_F(M2) - V_F(M1)} \times 40\ \mathrm{dB}$$

$$M_{VFmin} := 50\ \mathrm{dB\mu V} - \frac{V_F(M1) - V_F(M3)}{V_F(M2) - V_F(M1)} \times 40\ \mathrm{dB}$$

<u>VF - Dynamic</u> = M_{VFmax} - M_{VFmin}

18 Diagram 2



Test points to determine V_F linearity

VF - Linearity: is determined at 25 °C

$$\text{Slope} \quad : m = \frac{V_F(M2) - V_F(M1)}{40\ \text{dB}}$$

The tolerance range of the VF - linearity is determined by two parallel lines:

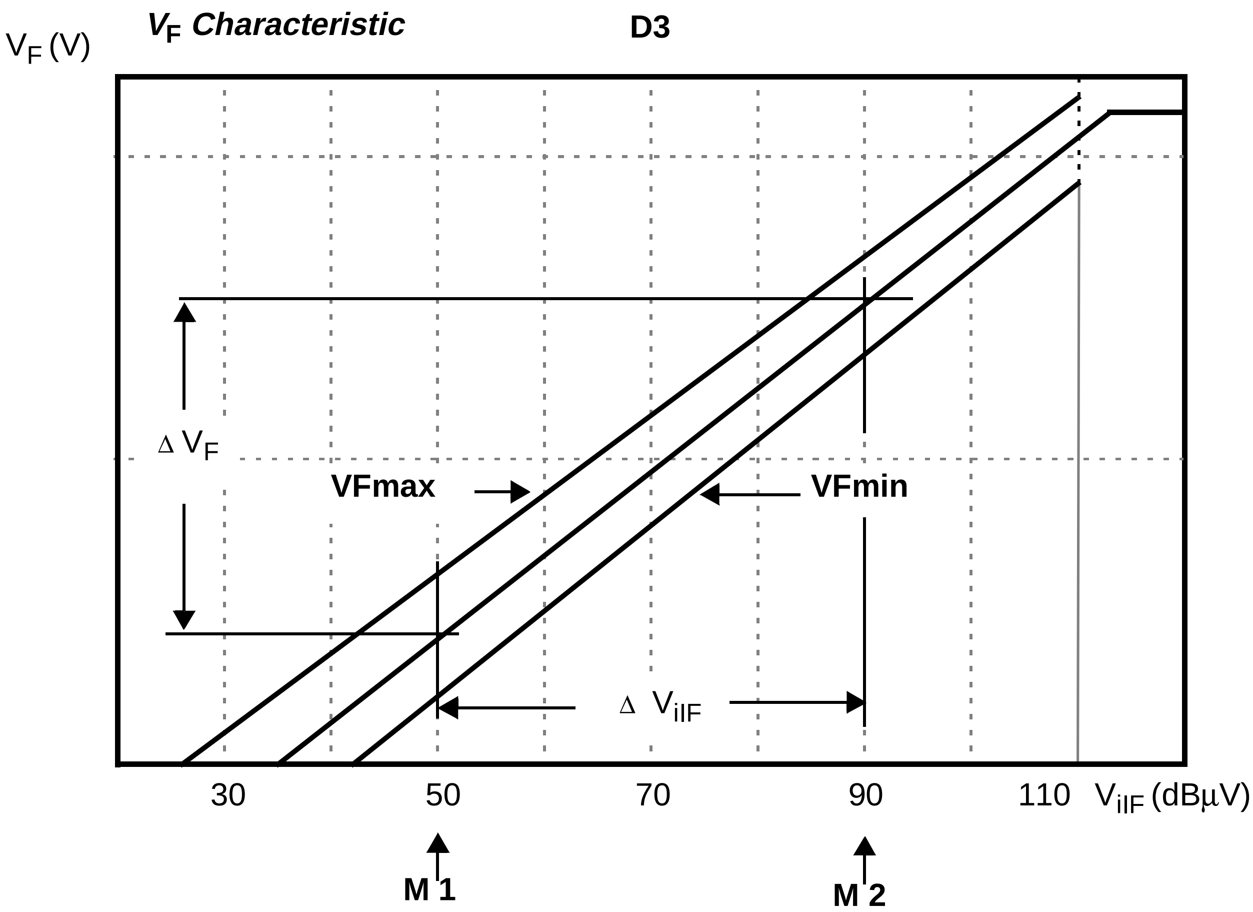
$V_{Fmax} = V_F\,(M1) + m\,(M + 60\text{ dB} + 1\text{dB})$

$V_{Fmin} = V_F\,(M1) + m\,(M + 60\text{ dB} - 1\text{dB})$

The V_F values within the V_F dynamic range ($M_{VFmin} \leq M \leq M_{VFmax}$) must be inside the predetermined tolerance range:

$$\mathbf{V_{Fmin} \leq V_F\,(M) \leq V_{Fmax}}$$

19 Diagram 3



V_F -Temperatur - Drift : It is determined within -40 bis +85 °C

$$\text{Slope} \quad : m = \frac{V_{F\,(M2)} - V_{F\,(M1)}}{40\ \text{dB}} \quad (\text{at } 25\ °C)$$

The tolerance range of the V_F temperature drift is determined by two parallel lines:

$V_{Fmax} = V_F\ (M1) + m\ (M + 60\ dB + 3dB)$

$V_{Fmin} = V_F\ (M1) + m\ (M + 60\ dB - 3dB)$

The V_F values for temperatures between -40 to +85 °C within the V_F dynamic range ($M_{VFmin} \leq VF \leq M_{VFmax}$) must be inside the predetermined tolerance field:

VFmin ≤ VF (M) ≤ VFmax